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To: Jim Woolford
From: Bob Wyatt
Date: October 2, 2018
Regarding: Portland Harbor cPAH Cleanup Level Update

Jim,

NW Natural very much appreciates the opportunity to provide you with more detail on our additional analysis of how the PAH cleanup criteria for Portland Harbor should be revised to reflect the updated IRIS cancer slope factor for benzo(a)pyrene (BaP). During our September 11 meeting, we provided an overview of our evaluation of three of the key factors EPA is considering at Portland Harbor. We also discussed the fact that EPA has determined that the direct contact risk associated with BaP is now approximately seven times less than was previously thought, and the risk of consuming shellfish in contact with sediments is approximately 27 times less than previously calculated. As we mentioned during the meeting, we believe EPA's revised cleanup requirements at Portland Harbor for cPAH and TPAH should reflect the magnitude of these changes. The three factors and our summary positions were:

1. *Human consumption of clams harvested from the navigation channel*. The Baseline Human Health Risk Assessment concluded that there is no human health risk from clam consumption in the navigation channel. That means that there should be no remedy required for that pathway. Even if clam consumption *had* been identified as a pathway for the navigation channel, no active remediation would be required. Cleanup in nearshore areas would reduce potential risks from clam consumption to well within EPA's acceptable risk range for the site. In fact, according to EPA's ROD residual risk evaluation, current clam consumption risks in navigation channel sediments are already within EPA's acceptable risk range.

2. *Protection of Surface Water.* The ambient water quality cleanup level for BaP based on the revised IRIS cancer slope factor should be 0.0009 µg/l. It is reasonable for EPA to apply a revised water quality criteria at Portland Harbor. Further, as ROD Appendix IV, Figure 4.2-8b shows, predicted surface water cPAH concentrations associated with the site for the "no action" alternative are already below the updated cleanup level and well below the most stringent Oregon water quality standard. Therefore, no cPAH cleanup of sediments is necessary to protect surface water quality for PAHs.

3. *Benthic Risk*. The revised cancer slope factor for BaP does not affect the calculation of benthic risk. EPA's ROD allows for delineation of benthic risk areas for active cleanup using the multiple lines of evidence approach used in the BERA. The ROD responsiveness summary clarifies that additional lines of evidence (e.g. toxicity testing) may be used to "refine delineation of benthic risk areas in areas that are not driven by risk via another RAO." Because PAH cleanup in the

navigation channel is not driven by risks to human health or protection of surface water, the application of TPAH RALs in the navigation channel is not necessary to protect the benthic community.

Our detailed supporting analysis is provided below.

Reconciliation of Updated B(a)P Toxicity Information and Portland Harbor Remedial Action Objectives Key Technical Issues

On January 19, 2017, EPA updated its Integrated Risk Information System (IRIS) by decreasing the oral cancer slope factor for benzo(a)pyrene (BaP) from 7.3 per mg/kg-day to 1 per mg/kg-day. This update reflects an approximate seven-fold decrease in calculated post-construction cancer risk from direct contact with BaP and, due to the log-log biota sediment accumulation regression equation used at Portland Harbor, an approximate 27-fold decrease in calculated post-construction cancer risk from shellfish consumption. Carcinogenic PAH cleanup levels for Portland Harbor, which are expressed as BaP equivalent values, should be updated as follows:

		ROD cleanup level	Updated cleanup level
In-water direct contact sediment	RAO 1	106 µg/kg[1]	774 µg/kg
Shellfish consumption sediment	RAO 2	39.5[2] µg/kg	1,080[3] µg/kg
Surface water	RAO 3	0.00012 µg/l	0.0009 µg/l[4]

[1] EPA's Baseline Human Health Risk Assessment identified potential risk from direct contact with cPAHs in nearshore in-water sediment to in-water workers, fishers, and divers. Based upon the BHHRA, EPA developed a direct contact PRG of 106 µg/kg for in-water sediment to be protective of tribal fishers. In the ROD, however, EPA selected a cPAH direct contact sediment cleanup level of 12 µg/kg, based upon background concentrations (which are equivalent to the PRG for the child recreational beach exposure scenario). Although EPA's cPAH in-water sediment cleanup level is based upon a child recreational beach exposure assumption, virtually all of EPA's evaluations supporting its remedy selection for nearshore sediments are based upon the 106 µg/kg PRG for tribal fishers. For example, the Remedial Action Levels for Total PAHs developed in the Feasibility Study and used to define action areas in the ROD were based on the 106 µg/kg cPAH PRG for in-water sediment exposure. The "highly toxic" principal threat waste concentration in the Feasibility Study and ROD is also based on the 106 µg/kg cPAH PRG. Most importantly, the Feasibility Study evaluated the performance of all alternatives (including the selected alternative) for EPA's Remedial Action Objective 1 (reduce risks to people from direct contact with chemicals in sediment and beaches) against the 106 µg/kg tribal fisher PRG. EPA's residual risk evaluations led it to conclude that its selected remedy would be protective of direct contact with sediments "immediately after construction." However, even a cursory review of EPA's residual risk tables in the final Feasibility Study reveals that the 12 µg/kg cPAH sediment cleanup level would not be met in almost every segment of the river at the rolling half-mile scale evaluated for RAO 1 immediately following construction.

[2] Portland Harbor ROD Table 17 sets the shellfish consumption sediment cleanup level at 3,950 µg/kg applicable to navigation channel sediments. We understand that EPA has identified an apparent unit error in the calculation of the preliminary remediation goal for shellfish consumption and believes the PRG should have been set at 39.5 µg/kg based on the former cancer slope factor. We have used the more conservative value in this table.

[3] Updated following equation presented in Appendix B of EPA's Feasibility Study.

[4] EPA's surface water cleanup level for Portland Harbor is based on the federal ambient water quality criteria rather than the risk assessment. In 2015, EPA stated that it "anticipates updating the AWQC for benzo(a)pyrene following finalization of EPA's IRIS toxicological assessment." *Update of Human Health Ambient Water Quality*

As we have previously presented to EPA,[5] adjusted nearshore RALs corresponding to the updated in-water direct contact sediment cleanup level could range from approximately 92,000 to 170,000 µg/kg.[6] The highly toxic principal threat waste (PTW) threshold would increase to 774,000 µg/kg.

We understand that EPA is concerned about redefining areas of active remedy to correspond to the updated IRIS assessment on three grounds: risk associated with human consumption of clams harvested from the navigation channel, protection of surface water, and benthic risk.

1. *Human consumption of clams harvested from the navigation channel*

The clam consumption cleanup level is the only human health-related cPAH or PAH cleanup level in the ROD applicable to the navigation channel. EPA's Baseline Human Health Risk Assessment (BHRRA) did not identify human consumption of clams harvested from the navigation channel as a complete exposure pathway and therefore did not assess potential risks associated with such consumption. In directing the exposure pathways to be evaluated in the BHRRA, EPA stated,

> It is unclear whether the maximum consumption rate for shellfish assumed in the risk assessment (18 g/day which is a little more than 1 pound per month (one pound in 3.6 weeks)) is sustainable at some or all of the areas where bivalves were collected, now or in the future. EPA believes that sufficient information exists to support the clam consumption scenario. However, EPA acknowledges that an appropriate exposure area should be determined in consideration of water depth (i.e. nearshore areas) and the area over which a sustainable shellfish harvest consistent with the clam consumption is possible.[7]

Accordingly, the final BHHRA identified no human health risk from clams harvested in the navigation channel.[8] EPA never deviated from this risk finding prior to the ROD, when it acknowledged that it could not technically support a cPAH sediment cleanup level based on fish consumption and substituted the clam consumption scenario[9] as a justification for petroleum cleanup in the navigation channel.[10]

Even if this risk pathway were supported by EPA's risk assessment, extensive remediation in the navigation channel is not necessary to address it. As shown in the figure below, cleanup in nearshore areas to even the least conservative adjusted TPAH RAL would reduce potential risks from clam

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Criteria: Benzo(a)pyrene 50-32-8, EPA 820-R-15-012 (June 2015). As a point of comparison, Oregon's water quality criteria for BaP (water + organism) is 0.0013 µg/l. OAR 340-041-8033, Table 40.

[5] *See,* Memorandum, *USEPA Updates to Human Health Toxicity Values for Benzo(a)pyrene and Potential Effects on Cleanup Levels and Remedial Action Levels in Portland Harbor* (Anchor QEA, August 2, 2017).

[6] Upper bound of TPAH RAL of 170,000 µg/kg equivalent to Alternative B in the FS.

[7] EPA Comments on Comprehensive Round 2 Site Summary and Data Gaps Analysis Report (January 15, 2008), page 26.

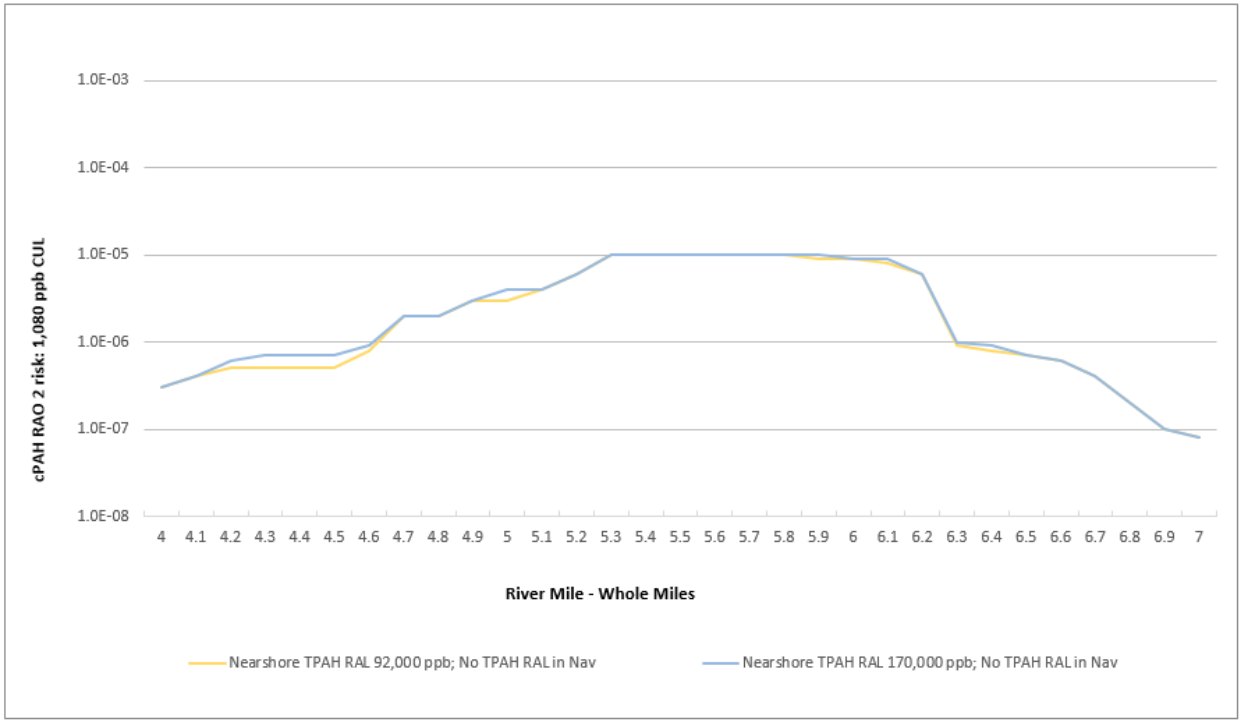
[8] See Map 5-4.1 (Portland Harbor RI/FS Appendix F, March 28, 2013 – Risks from Clam Consumption, RME).

[9] *See Portland Harbor RI/FS, Revised Draft Bioaccumulation Modeling Report* (June 19, 2015), Table 4-1.

[10] See also EPA's April 21, 2010 letter providing direction on PRGs for use in the Feasibility Study and attached Table 1 ("B(a)P HH Clam Consumption. EPA considered making alternative water depth or consumption exposure assumptions but prefers using assumptions consistent with the risk assessment.")

consumption to well within EPA's acceptable risk range[11] at the completion of construction without any active TPAH cleanup in the navigation channel.[12] In fact, according to EPA's ROD residual risk evaluation, current clam consumption risks in navigation channel sediments are within EPA's acceptable risk range at the updated cleanup level.

Post Construction Clam Consumption Risk
RM 4-7 Whole River Miles
Log Scale



2. *Protection of Surface Water*

As noted above, EPA anticipates updating the BaP ambient water quality criteria consistent with the 2017 toxicological assessment. The updated cleanup level for protection of surface water should be 0.0009 µg/l. Because remedy implementation is still a number of years in the future, the new water quality criteria will almost certainly be in effect at the time cleanup commences. The most stringent Oregon water quality standard (0.0013 µg/l) is less stringent than the EPA AWQC.

EPA's FS estimated surface water concentrations following implementation of the various remedial alternatives. As ROD Appendix IV, Figure 4.2-8b (below) shows, predicted surface water cPAH concentrations associated with the site for the "no action" alternative are already below the updated cleanup level and well below the most stringent Oregon water quality standard.[13] Therefore, no

[11] Carcinogenic risk between 10-6 and 10-4 per National Contingency Plan (NCP), 40 CFR 300.430(e)
[12] Figure shows residual risk calculated on a whole river mile basis, the smallest scale evaluated in the BHRRA for consumption scenarios not limited by water depth. See BHHRA §3.4.5.
[13] Note that EPA's selected alternative, F Mod, would not itself attain protection of the current cPAH cleanup level immediately following construction of remedial actions.

petroleum cleanup of sediments is necessary to protect surface water quality for PAHs, but application of adjusted TPAH RALs in the nearshore and remediation of areas of PTW-NAPL will reduce cPAH water concentrations below current levels.

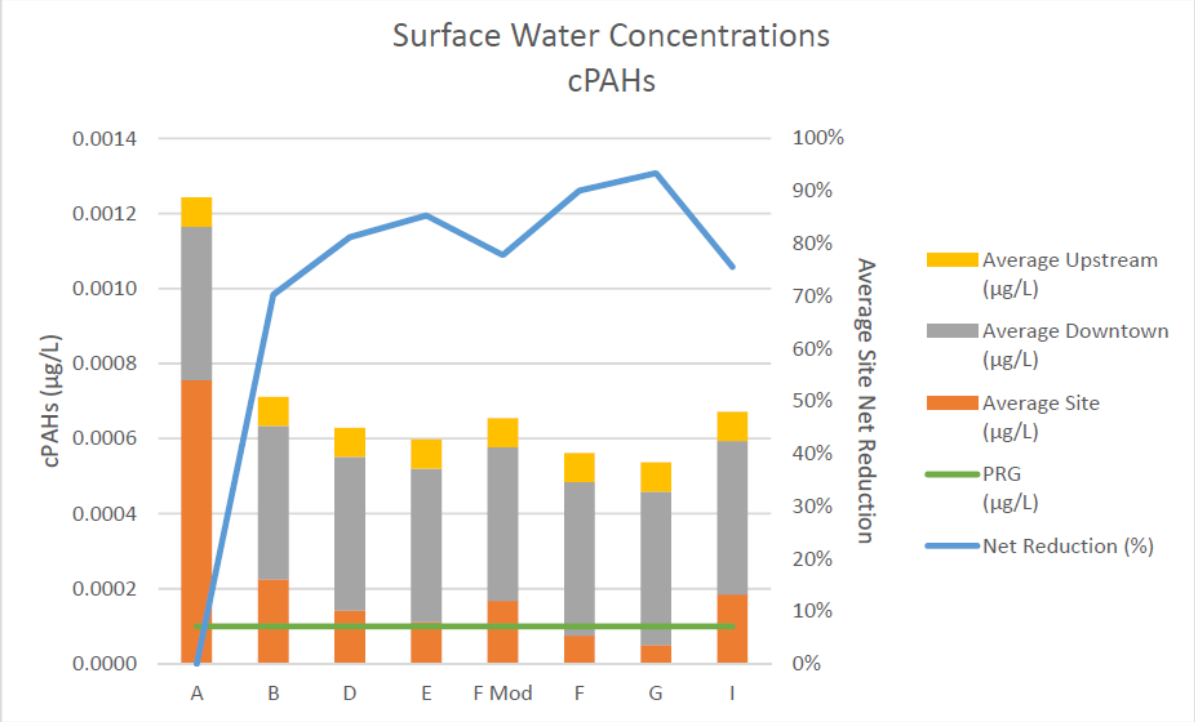


Figure 4.2-8b. Predicted surface water cPAH concentration reductions.

3. *Benthic Risk*

The assessment of potential ecological risk (RAO 5) would, of course, not be affected by the change in the human health cancer slope factor. Table 17 of the ROD does not identify the basis for the PAH PRG of 23,000 ppb, but we understand it to be for protection of benthic organisms.

EPA's Baseline Ecological Risk Assessment (BERA) used a multiple lines of evidence approach to evaluate benthic risk. Although EPA adopted a different approach for estimating benthic risk in the ROD,[14] the ROD responsiveness summary clarifies that additional lines of evidence (e.g., toxicity testing) may be used to "refine delineation of benthic risk areas in areas that are not driven by risk via another RAO." Because, as discussed above, petroleum cleanup in the navigation channel is not driven by risks to human health or protection of surface water, EPA's ROD allows for delineation of benthic risk areas for active cleanup using the multiple lines of evidence approach used in the BERA. Therefore, application of TPAH RALs in the navigation channel is not necessary to protect the benthic community.

[14] *See, e.g.,* Portland Harbor RI Appendix G, p. 774 ("[u]nacceptable risks to benthic invertebrates are located in approximately 4-8 percent of the Site,"); *cf.* ROD, Appendix IV, Table 4.2-7 (1,289 acres of benthic risk within the 2,190 acre Portland Harbor Site, or approximately 59% of the Site).

Conclusion

EPA's risk assessment did not identify human consumption of clams from the navigation channel as a risk. Even if it had, cleanup of petroleum in the nearshore areas to even the least conservative adjusted TPAH RAL would reduce potential risks from clam consumption to well within EPA's NCP acceptable risk range at the completion of construction without any active TPAH cleanup in the navigation channel. Site contributions to cPAH surface water concentrations are already below the updated cleanup level at the no action alternatives, and those concentrations will be further reduced through active remediation of areas defined by nearshore TPAH RALs and PTW-NAPL. Benthic risk can be delineated and addressed consistent with the ROD through the multiple lines of evidence approach used in the BERA.